

SWAMSI Cymbals Projector

Dr. Thomas R. Howarth
Naval Sea Systems Command Division Newport
Code CC4
1176 Howell Street
Newport, RI 02841
Phone: 401.832.2544 Email: howarthtr@npt.nuwc.navy.mil

Document Number: N0001406WX20668

LONG TERM GOAL

To design, fabricate and deliver a cymbal projector for the MIT vehicle in support of the SWAMSI program.

OBJECTIVE

To provide a broadband acoustic projector that can be placed within the MIT BlueFin test vehicle and provide acoustic output over the band of 1 kHz through 20 kHz.

APPROACH and WORK COMPLETED

The design of this projector is similar to that done for the NRL BMIS system and commonality of parts and fabrication tooling and techniques were used. After a planning meeting at MIT, a specific projector design was selected. Long term parts procurements were conducted and the fabrication was conducted at NSWC-Crane. Upon fabrication, electroacoustic testing was done at NAVSEADIVNPT. In parallel with the projector design, a design of the driving electronic scheme and housings was completed with late FY06 orders for long term procurements. It is expected that the electronics will be fabricated in FY07 and then delivered to MIT for use in their BlueFin vehicle.

Technical support was provided by Kim Benjamin and Dr. Dehua Huang of NAVSEADIVNPT. Fabrication was provided by Scott Small and Derek Lengacher of NSWC-Crane. Measurements were provided by Rene LeFleur, Hugo Mendoza and Walter Boober of NAVSEADIVNPT.

RESULTS

Fig. 1 shows the measured in-air admittance magnitude for each of the 4 staves in the cymbals array before polyurethane encapsulation. Note the lower resonance frequency at 7 kHz. The admittance magnitude provides an insight into the mechanical behavior and hence, expected acoustical behavior, of the transducer. Fig. 2 shows a composite in-air measurement after encapsulation and then again after a 6 week aging. Note that the lower frequency resonance dropped to approximately 4500 Hz because of the encapsulation. It should also be noted that the responses are much cleaner and closer after the 6 week aging as their properties are creeping together similarly.

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 30 SEP 2006		2. REPORT TYPE		3. DATES COVERED 00-00-2006 to 00-00-2006	
4. TITLE AND SUBTITLE SWAMSI Cymbals Projector				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Sea Systems Command Division Newport, Code CC4, 1176 Howell Street, Newport, RI, 02841				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 4	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

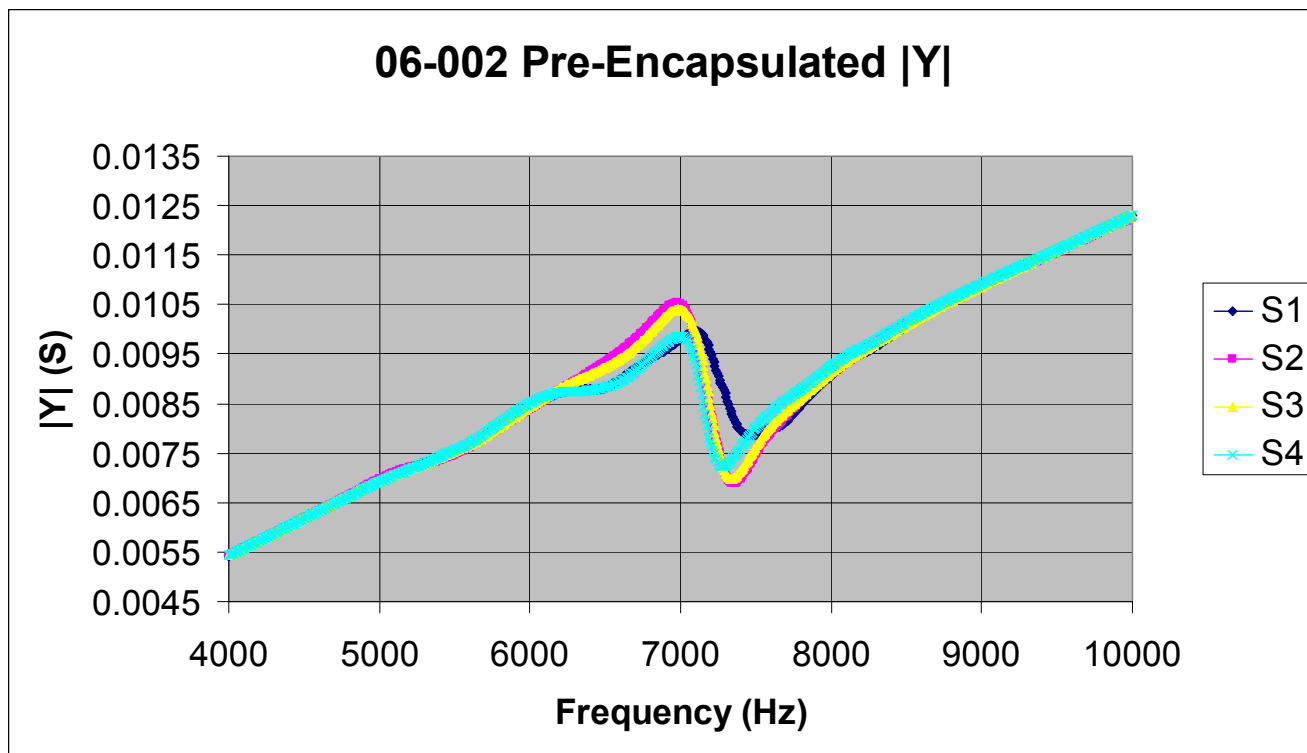


Fig. 1: Measured in-air admittance of each stave in the cymbal array before polyurethane encapsulation.

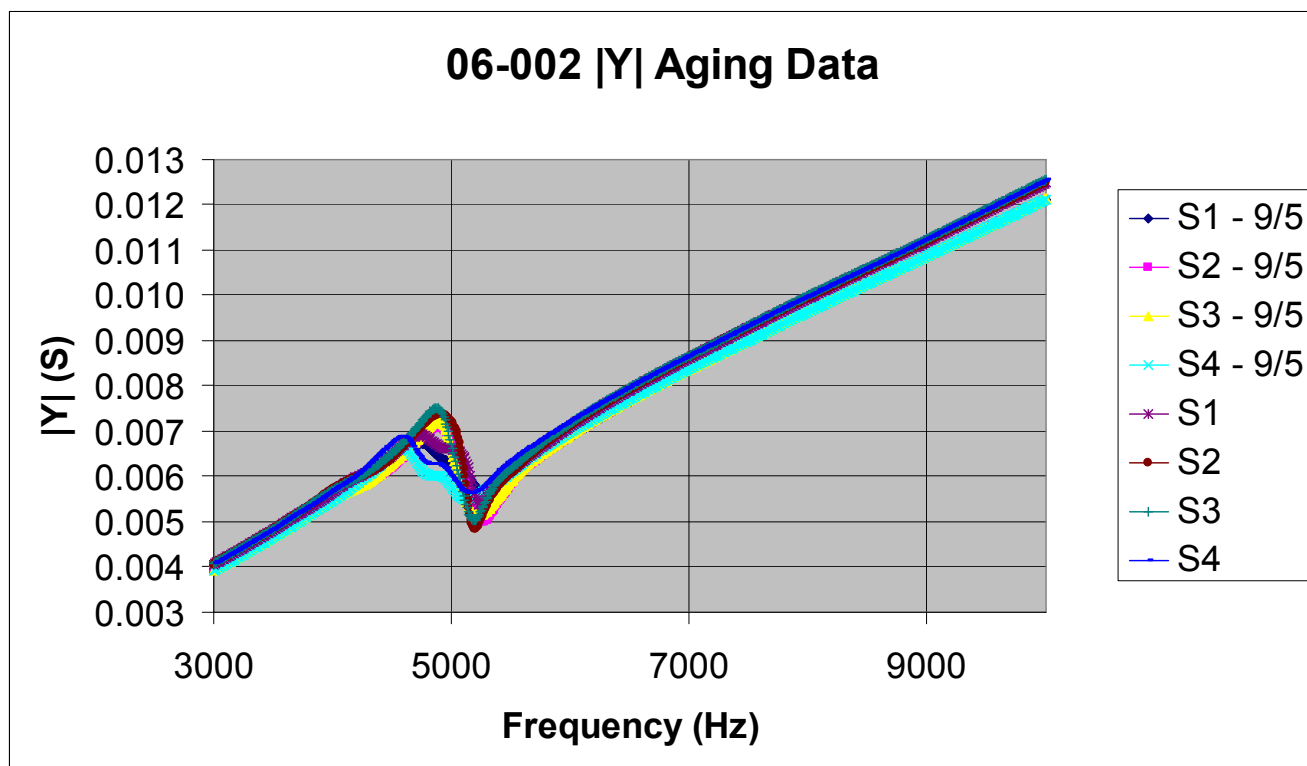


Fig. 2: Measured in-air admittance magnitude of the four staves after encapsulation and then measured 6 weeks later after “aging”.

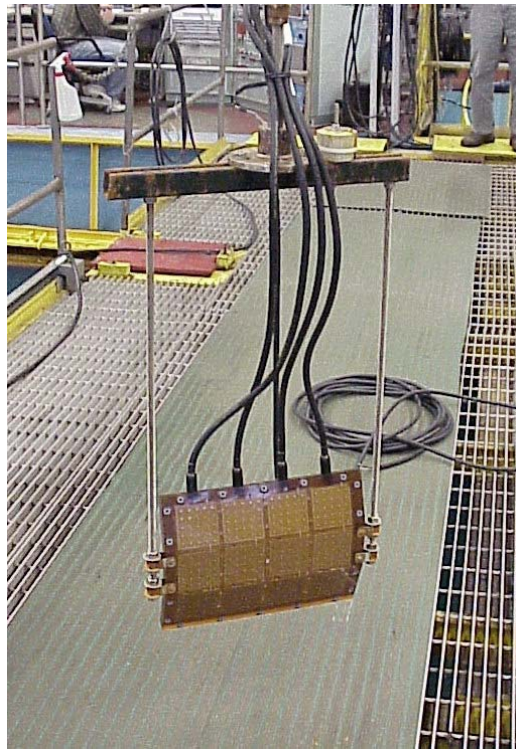


Fig. 3: Photograph of cymbal panel prior to electroacoustic testing.

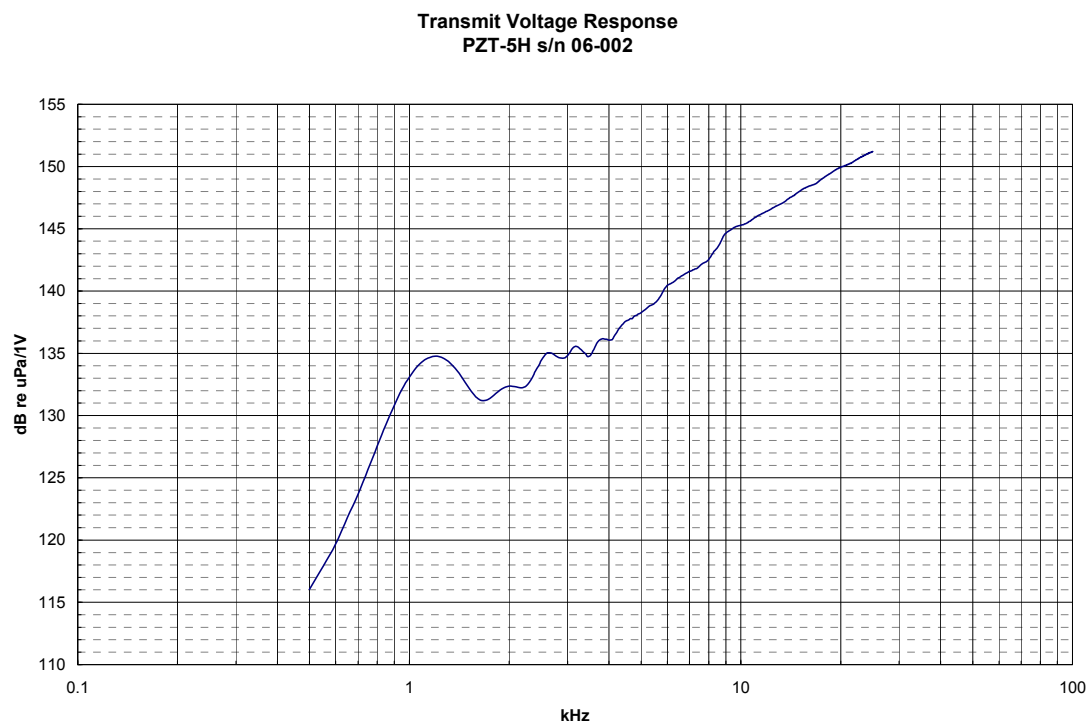


Fig. 4: Measured transmitting voltage response of cymbal panel.

A photograph of the completed array is shown in Fig. 3 as it is mounted for electroacoustic testing. Fig. 4 is a plot of the measured transmitting voltage response where all four of the staves are electrically tied together in parallel. Note that this measurement shows that the desired low frequency resonance has been lowered to 1.2 kHz. The measured directivity patterns showed excellent agreement for those expected from a rectangular piston source of the same radiating dimensions. The array was tested in a free field, unbacked condition where upon application into the vehicle, expectations of a 3-5 dB increase in sound transmission across the frequency band are expected.

IMPACT/APPLICATIONS

The application of this array within the SWAMSI project will be completed in FY07 when the electronic drive system is procured, fabricated, tested and delivered. The implication of transitioning this transduction technology into SWAMSI will be to provide a lower and broader frequency acoustic output while maintaining broader directivity than is presently being accomplished with the COTs approach. The implementation of the cymbal technology is expected to offer increased performance for the SWAMSI approach.

RELATED PROJECTS

Naval Research Laboratory's Broadband Mine Identification System (BMIS) which uses the original cymbal projector design for a monostatic source.

PUBLICATIONS

J. F. Tressler, T. R. Howarth and D. Huang, "A comparison of the underwater acoustic performance of single crystal vs. piezoelectric ceramic based 'cymbal' projectors," Journal of the Acoustical Society of America, **119** (2), 879-889, 2006. [refereed].